Proton conducting dense ceramic membranes for hydrogen separation and Membrane reactor applications

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This project is aimed at preparation of thin membranes of a modified strontium ceramic material on porous substrates with improved hydrogen permeance. The research work conducted in this reporting period was focused on studying synthesis methods for preparation of thin thulium doped strontium cerate ($SrCe_{0.95}Tm_{0.05}O_3$, SCTm) membranes. The following two methods were studied in the past year: (1) polymeric-gel casting and (2) dry-pressing. The polymeric-gel casting method includes preparation of mixed metal oxide gel and coating of the gel on a macroporous alumina support. Micrometer thick SCTm films of the perovskite structure can be obtained by this method. However, the deposited films are not hermetic and it may require about 50 coatings in order to obtain gas-tight SCTm films by this method. Asymmetric SCTm membranes consisting of a thick macroporous SCTm support and a thin SCTm layer can be effectively prepared by the dry-pressing method. The membranes were prepared by pressing together a thick layer of coarse SCTm powder and a thin layer of finer SCTm powder, followed by calcination and sintering under proper conditions. The asymmetric SCTm membranes have desired phase structure and are hermetic. Hydrogen permeation flux through the SCT membranes is inversely proportional to the thickness of the dense layer of the asymmetric membranes. The results show a substantial improvement in hydrogen permeation flux by reducing the SCTm membrane thickness.

List of Publications/Presentations (DE-FG26-00NT40818)

Papers Published or Submitted:

X. Qi, S. Cheng, Y.S. Lin, "Modeling and experimental study of hydrogen permeation through proton conducting ceramic membranes", Proceedings of Electrochemical Society, Volume 2001-28 (Ionic and Mixed Conducting Ceramics), 1-5 (2002)

X. Qi and Y. S. Lin, "Modeling of hydrogen permeation through proton conducting ceramic membranes", *Solid State Ionics*, Submitted (2002)

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